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PATENT APPLICATION AF/4

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IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): ARLEN L. ROESNER et al.

Confirmation No.: 8101

Application No.: 10/017,543

Examiner: CHERVINSKY, BORIS

Filing Date: 12/13/01

Group Art Unit: 2835

Title: THERMAL INTERFACE

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TRANSMITTAL OF APPEAL BRIEF

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(complete (a) or (b) as applicable)

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PATENT
Attorney Docket No: 10014774-1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: ARLEN L. ROESNER et al.

Art Unit: 2835

Examiner: Boris Chervinsky

Serial No: 10/017,543

Filed: December 13, 2001

For: THERMAL INTERFACE

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Inventors: Arlen L. Roesner, et al.

Serial No.: 10/017,543 **Art Unit:** 2835

Filed: December 13, 2001 **Examiner:** Chervinsky, Boris L.

Title: THERMAL INTERFACE

BRIEF ON APPEAL

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Inventors: Arlen L. Roesner, et al.
Serial No.: 10/017,543 **Art Unit:** 2835
Filed: December 13, 2001 **Examiner:** Chervinsky, Boris L.
Title: THERMAL INTERFACE

BRIEF ON APPEAL

1. Real Party in Interest

The real party in interest is Hewlett-Packard Company, Palo Alto, California, the owner and assignee of the subject application.

2. Related Appeals and Interferences

The rejected claims were the subject of Appeal No. 2003-1412 wherein the Board, on June 30, 2003, issued a "Decision on Appeal and Opinion" (Paper No. 14) reversing the Examiner's October 24, 2002, final rejection (Paper No. 7) of the claims and remanding the case for further consideration.

There are no known related interferences.

3. Status of Claims

This is an appeal from the Examiner's December 9, 2003, final rejection of claims 1-30 (Paper No. 17). No claim has been allowed and no claim has been canceled.

4. Status of Amendments

No amendment has been filed in this application subsequent to the Final Office Action dated December 9, 2003.

5. The Invention of the Appealed Claims

a. The Problems Faced By The Prior Art

Many electronic components such as semiconductor packages, whether containing integrated circuits or individual devices such as diodes or power transistors, dissipate sufficient heat to require thermal management utilizing heat sinks.

Thermal interfaces have been developed for transferring the heat produced by a heat-dissipating electronic component to a heat sink. A thermal interface may simply comprise a thin film or layer of a thermally conductive filler material such as silicone grease. Because silicone grease remains semi-liquid at room temperature, the electronic component and the heat sink may be readily separated to facilitate field servicing, component upgrades, and so forth. However, silicone grease is not favored because it is a messy contaminant that is not easily removed from clothing or equipment.

Other filler materials in common use include thermal compounds comprising a paraffin base with additives for enhancing thermal conductivity. Such compounds are characterized by temperature responsive phase-changes so that the compound is dry, clean and therefore easy to handle at room temperature but liquefies at elevated temperatures so that the material flows into the irregularities in the confronting surfaces of the heat sink and the electronic component. The disadvantage of such phase-change compounds is that when they revert to the solid state upon cooling, they tend to bond to the surfaces to which they have been applied so that separation of the electronic component and the heat sink may be difficult.

Multilayer thermal interfaces adapted to be interposed between a heat-dissipating electronic component and a heat sink are also known. One such known interface comprises a thin, thermally-conductive metal foil coated on both sides with a paraffin-base, change-of-state thermal compound.

Another known multilayer thermal interface comprises four layers, including a pair of metal foils sandwiched between outer layers of a paraffin-base, change-of-state compound. Four-layer interfaces, however, tend to increase the thermal impedance of the joint.

Prior to the present invention, there remained a need for a thermal interface for efficiently transferring heat away from a heat-dissipating electronic component to a heat sink, wherein the thermal interface facilitates separation of the heat sink from the electronic component, yet is clean, easy to handle and has a minimum number of layers.

b. The Solution Provided By The Appealed Claims

In accordance with one specific, exemplary embodiment of the invention, there is provided a thermal interface comprising a carrier having opposed surfaces, a layer of a phase-change material such as a paraffin-base change of state thermal compound on one of the surfaces of the carrier, and a layer of a pliable, thermal compound such as a silicone grease on the other of the surfaces of the carrier.

In accordance with another specific, exemplary embodiment of the present invention, there is provided a thermal interface product that comprises a thermal interface as described above and that additionally comprises a removable, protective covering overlying the pliable, thermal compound layer.

Pursuant to yet another specific, exemplary embodiment of the present invention, there is provided an assembly comprising a substrate, an electronic component mounted on the substrate, a heat sink, and a thermal interface as described above interposed between a surface of the electronic component and a confronting surface of the heat sink for transferring heat generated by the electronic component to the heat sink.

More specifically, FIG. 1 shows an assembly 10 comprising a heat-dissipating electronic component 12 mounted

on a substrate 14, a heat sink 16 for dissipating heat generated by the electronic component, and a thermal interface 18 constructed in accordance with the present invention. The thermal interface is adapted to be interposed between and to thermally couple a surface 20 of the heat sink 16 with a surface 22 of the electronic component 12.

With reference to FIG. 2, there is shown a thermal interface product 30 including the combination of the thermal interface 18 and a removable protective covering in the form of a backing sheet or release liner 32.

The thermal interface 18 basically comprises a three-layer structure. A first layer 34 comprises a thermally-conductive phase-change compound applied to a first surface 36 of a second interface layer 38 comprising a thin, thermally-conductive metal or plastic carrier. The third layer 40 of the thermal interface 18 comprises a silicone-type grease or paste applied to a second surface 42 of the carrier 38. The grease layer 40 has an outer surface 44 covered by, and in contact with, the removable backing sheet or release liner 32.

In use, the protective release liner 32 is peeled away from the grease layer 40. The liner 32 can be discarded without the grease coming in contact with the user. The thermal interface 18 is then sandwiched between the confronting surfaces 20 and 22 of the heat sink 16 and the electronic component 12

Should disassembly be required, separation of the components along the pliable, non-solid grease layer 40 is easily accomplished.

FIGS. 3-5 show a thermal interface product 50 in accordance with an alternative embodiment of the invention. The product 50 comprises a three layer thermal interface 52 comprising, as before, a carrier 54 having opposed surfaces one of which supports a layer 56 of thermally-conductive, silicone-type grease or paste, and the other of which receives a layer 58 of thermally-conductive phase-change material.

Instead of a thin, flexible liner that contacts the grease layer as in the first embodiment (FIG. 2), overlying the grease layer 56 in the embodiment of FIGS. 3-5 is a removable protective covering in the form of cap 62 that does not contact the grease layer.

When the thermal interface 52 is ready for installation, the cap 62, which covers and protects the grease layer 56 during shipment, is removed by simply pulling up on a lift tab 68.

The invention combines the advantages of each of the three thermal interface materials while eliminating or minimizing their respective disadvantages. The invention combines the cleanliness and thermal performance of a phase-change material, the thermal performance and non-adhesion of a thermal grease, and the ease of handling a foil or film carrier. Further, the thermal interface product minimizes the chances of a user contacting the grease, and particularly so during initial fabrication of the assembly. Moreover, the thermal interface of the invention has only three layers thereby optimizing heat transfer from the electronic component to the heat sink.

6. The Issues On Appeal

The issues involved in this appeal are:

a. Whether claims 1-9 and 22-30 are unpatentable under 35 USC 103(a) for obviousness over Green, et al., U.S. Patent 6,197,859 (hereinafter "Green"), in view of Brzezinski, U.S. Patent 5,608,610 (hereinafter "Brzezinski");

b. Whether claims 10, 11 and 13-21 are unpatentable under 35 USC 103(a) for obviousness over Green in view of Brzezinski and further in view of Tzeng, et al., U.S. Patent 6,245,400 (hereinafter "Tzeng"); and

c. Whether dependent claim 12 is unpatentable under 35 USC 103(a) for obviousness over Green in view of Brzezinski

and further in view of Tzeng (as applied to claim 10) and Lee, et al., U.S. Patent 6,049,458 (hereinafter "Lee").

7. Grouping of the Claims

Claims 1, 10 and 22 are independent.

Claims 1-9 and 22-30 stand or fall together.

Claims 10, 11 and 13-21 stand or fall together.

Dependent claim 12 stands with claim 10 from which it depends, but in view of the additional patentable distinctions set forth therein, would fall separately from claim 10.

8. Arguments

a. The Prior Art Disclosures

(1) The Green Patent

The Green patent describes in the "Background of the Invention" thereof, various phase-change thermal interface compounds that may be applied to one or both surfaces of a suitable substrate. (Green, 1/15-61.) Green also discloses in the "Background" thereof the use of a single layer of thermally conductive silicone grease between an electronic package and a mounting surface. Green notes the disadvantage of silicone grease, namely, that the products on which it is used become messy. (Id., 2/27-49.) A principal object of the Green patent is to avoid silicone grease and provide instead a thermally conductive coating that has consistent and uniform thickness and therefore predictability of performance, with the advantages to be obtained "without experiencing the problems inherent in applications of silicone grease"; those "problems" are described by Green in detail in column 2, lines 41-61.

Green's contribution is a specific dry film, phase-change material formulation, namely, a thermally stable wax formed as an alkyl substituted poly (hydro, methyl-siloxane) wax polymer. Green discloses in Figs. 1A, 1B, 2 and 3, various devices incorporating a single coating of Green's dry film

composition. In Fig. 4, Green discloses an interface member 43 comprising a metal foil substrate 44 coated on both sides with identical layers 45 and 46 of Green's dry film, phase-change composition.

The dry film, phase-change composition of the Green patent is applied on one side of a substrate (FIGS. 1A, 1B, 2 and 3) or on both sides of a substrate (FIG. 4). More specifically, in FIG. 4 a metal foil substrate 44 is coated on one side with a layer 45 of the dry film, phase-change composition of the Green invention and similarly on the other side with a layer 46 of the same dry film, phase-change composition.

(2) The Brzezinski Patent

Brzezinsky discloses in Fig. 1 a dual heat sink, "floating" multi-chip module 10 that encloses a flexible, conformable, leak-proof metallic membrane 56 one side of which bears against the passive sides of chips 28-38 in a first chamber 24. A synthetic thermal grease may be used to coat the passive sides of the chips 28-38. (Brzezinski, 7/12-16.) The other side of the membrane 56 faces a second chamber filled with a volume of thermally conductive liquid 58. Various liquids are disclosed, including distilled water with ten percent ethylene glycol; a synthetic Freon; and "phase-change salts which quickly give up energy when caused to boil" (6/29-37).

(3) The Tzeng Patent

The Tzeng patent relates to a release-lined, pressure sensitive adhesive, flexible graphite thermal interface. The Tzeng interface comprises a flexible graphite substrate 11, an adhesive primer coating 12 on the substrate, a pressure sensitive adhesive coating 13 on the primer coating and a release liner 14 on the pressure sensitive adhesive coating. The release liner 14 is said to be easily removed without any

significant delamination of the flexible graphite substrate. (Tzeng, 2/3-9.)

(4) The Lee Patent

Lee discloses a heat sink 30 for dissipating heat generated by a CPU. The heat sink includes a base 31, heat dissipating fins 32 projecting from the base and a layer of thermal grease 40 spread on a middle portion of the heat sink base. A protective cap 50 is removably attached to the base to enclose the thermal grease so that the grease will not cause contamination during transportation or handling of the heat sink. (Lee, 2/31-35.)

b. The First Appeal

In the final Office Action that gave rise to the first appeal, the Examiner rejected claims 1-4, 6-9, 22-25 and 27-30 as anticipated by Green; claims 5 and 26 as unpatentable for obviousness over Green; claims 10, 11 and 13-21 as unpatentable for obviousness over Green in view of Tzeng; and claim 12 as unpatentable for obviousness over Green in view of Tzeng, further in view of Lee. (Paper No. 7.)

In its decision on June 30, 2003 (Paper No. 14) the Board reversed these final rejections.

The Board made the following findings, among others:

(1) That the composition containing phase-changing alkyl substituted poly (hydro, methyl-siloxane) wax polymers taught by Green is solely a "phase-change material" and not a "pliable, thermal compound"[1];

(2) That one of ordinary skill in the art would understand from the specification that the claimed "phase-change material" is "a material which changes phase, in this case from solid at room temperature to at least partially liquid at higher temperatures"; and

[1] Despite this finding, the Examiner continues to erroneously equate these different materials. (See Final Office Action dated Dec. 9, 2003, Paper No. 17, page 2, par. 2.)

(3) That Green does not disclose the elements of a thermal interface arranged as specified in appealed independent claims 1, 10 and 22 and therefore does not anticipate any of the claims under Section 102. (Decision on Appeal, Paper No. 14, pages 2 and 3.)

Declining to exercise its authority under 37 CFR §1.196(b), the Board instead returned the application to the Examiner and suggested that the Examiner:

> . . . consider whether one of ordinary skill in this art would have found in the prior art the reasonable suggestion to modify the thermal interface structures disclosed by Green and any other reference(s) developed by the examiner, such as United States Patent 5,912,805 which is described by appellants to disclose a double 'phase-change material' sided thermal interface structure (see specification, page 2), by adding a 'pliable, thermal compound' as a layer on the opposite side of a substrate from a 'phase-change material' in a single 'phase-change material' sided thermal interface (see Green, col. 1, lines 53-55), or by interchanging a 'phase-change material' layer with a 'pliable, thermal compound' in a double 'phase-change material' sided thermal interface structure, in the reasonable expectation of obtaining a double sided structure useful as a thermal interface. (Paper No. 14, p. 5.)

In response to the Board's suggestion, the Examiner cited Brzezinski apparently in support of a purported suggestion to modify the double-sided phase-change material thermal interface structure of Fig. 4 of Green by substituting a pliable, thermal compound material layer for one of the phase-change material layers in Green.

c. The Examiner's Rejections In This Appeal

Claims 1-9 and 22-30 stand finally rejected as unpatentable under 35 USC 103(a) for obviousness over Green in view of Brzezinski;

Claims 10, 11 and 13-21 stand finally rejected as unpatentable under 35 USC 103(a) for obviousness over Green in view of Brzezinski and further in view of Tzeng; and

Dependent claim 12 stands finally rejected as unpatentable under 35 USC 103(a) for obviousness over Green in view of Brzezinski and further in view of Tzeng (as applied to claim 10) and Lee. (Paper No. 17.)

d. The Examiner's Rejections Are Erroneous

(1) The Examiner's Rejections of Independent Claims 1 And 22 Along With Dependent Claims 2-9 And 23-30 As Unpatentable For Obviousness Over Green In View Of Brzezinski Are Erroneous

Claim 1 sets forth a thermal interface comprising:

> a carrier having opposed surfaces;
> a layer of a phase-change material on one of the surfaces of the carrier; and
> a layer of a pliable, thermal compound on the other of the surfaces of the carrier.

Independent claim 22 provides an assembly comprising a substrate, an electronic component mounted on the substrate, a heat sink, and a thermal interface as described above interposed between a surface of the electronic component and a confronting surface of the heat sink for transferring heat generated by the electronic component to the heat sink.

The Examiner apparently finds in the Green and Brzezinski references a suggestion to modify the thermal interface structure of Fig. 4 of Green by substituting for one of the dry film phase-change coatings 45 and 46 in Fig. 4 a layer of a pliable, thermal compound. Applicants respectfully disagree that such a suggestion can be extracted from the applied references. Given the disparate teachings of the references, it is anything but clear just how one ordinarily skilled in the art having these two references before him would go about combining them in any rational manner, let alone in the way that is apparently being urged by the Examiner. It bears repeating that both the suggestion of the modification and the reasonable expectation of success must be found in the prior

art and not in the applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991).

Brzezinski's thermal management scheme differs in critical respects from Green's. On one side of the conformable membrane in Brzezinski is a chamber or cavity filled with a working liquid, preferably distilled water because of its chemical compatibility and its high latent heat. Brzezinski proposes alternatively to fill the second chamber with a liquid comprising "phase-change salts which *quickly give up energy when caused to boil*". (Col. 6, lines 34-36; emphasis added.) It is thus clear that here Brzezinski uses the latent heat of vaporization accompanying a liquid-to-vapor phase change to extract heat from the multi-chip module. Nothing remotely similar is involved in Green. Moreover, it is clear that the phase-change liquid disclosed by Brzezinski is not a "phase-change material" within the meaning of that term as construed by the Board in the first appeal.

To summarize: Green, et al., disclose as their invention the use of identical wax polymer coatings on both sides of a substrate; silicone grease coatings are mentioned but described as having "problems inherent" in their application. Brzezinski discloses a chamber filled with a vaporizable liquid on one side of a substrate and a thermal grease on the other. What is one of ordinary skill, having before him these disparate references, but not the disclosure of the present application, to make of them?

At bottom, in support of this rejection, the Examiner, seizing upon the "phase-change" language in Brzezinski, has simply extracted the grease coating from Brzezinski and, having removed it from the context of Brzezinski's evaporative cooling system, concludes that it would have been obvious to substitute that coating for one of the dry film phase-change coatings in Green. But the cited art fails to suggest such a modification, and the Examiner has not

identified any such teaching that, in fact, can only be found by recourse to the applicants' disclosure.

Moreover, the reasons given by the Examiner in support of the purported obviousness of modifying Green in view of Brzezinski (Final Office Action, Paper No. 17, p. 3) are not persuasive. Reason (a), that grease coatings are well known may be true but, as noted above, Green explains in detail why such coatings are to be avoided; the fact is that Green clearly teaches away from the use of such a material. There is nothing in these references that would encourage or motivate a skilled worker to substitute the grease coating mentioned in Brzezinski for one of the dry film phase change coatings in Green; there is no teaching in favor of it, but there is a cogent teaching against it. (Green, col. 2, lines 41-61.)

In selecting a thermal interface material for transferring the heat produced by a heat-dissipating electronic component to a heat sink, Green, et al., clearly considered and rejected conventional silicone grease, believing that material to have such "problems inherent" in its application that it is rendered unsuitable. Therefore, a skilled artisan would be directed away from making the modification suggested by the Examiner.

It will be evident that appellants do not rely on this "teaching away" alone in support of the nonobviousness of the claimed invention. Separate and apart from Green's "teaching away", there simply is no teaching in the references for the Examiner's suggested modification so as to arrive at the combination of elements presently claimed. Accordingly, In re Gurley, 27 F.3d 551, 31 USPQ2d 1130 (Fed. Cir. 1994), cited by the Board (Paper No. 14, page 5) and by the Examiner (Paper No. 17, page 4), is inapposite. There, unlike the present case in which the rejection based on Green alone was reversed, the applicant was unable to distinguish his claimed product from that described in the single cited reference. Thus, the

"teaching away" argument was deemed "insufficient" to establish patentability. (In re Gurley, 31 USPQ2d at 1132.)[2]

With respect to the Examiner's reasons (b)-(d), these are not based on anything in the references, and the Examiner has provided no support for them.

In summary, applicants respectfully submit that the Examiner's attempted combination of Green and Brzezinski amounts to a prohibited hindsight reconstruction. In re Bond, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). These references, whether viewed singly or in combination, do not suggest modifying the double "phase-change material" sided thermal interface of Fig. 4 of Green by interchanging one of the "phase-change material" layers with a "pliable thermal compound".

Appellants further submit that the references are equally devoid of any teaching for adding a pliable, thermal compound layer to the opposite side of a substrate from a "phase-change material" in a single phase-change material sided thermal interface.

In view of the foregoing, it is submitted that independent claims 1 and 22 are patentable over the applied references. It is axiomatic that if an independent claim is patentable, the claims dependent therefrom are likewise patentable. In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). Therefore, it is submitted that like claims 1 and 22, dependent claims 2-9 and 23-30 are patentable.

(2) The Examiner's Rejections Of Independent Claim 10 And Dependent Claims 11 and 13-21 As Unpatentable For Obviousness Over Green In View Of Brzezinski Further In View Of Tzeng Are Erroneous

[2] Appellants believe that Gurley, in fact, is an anticipation case, rather than one involving obviousness. In Gurley, the single reference exactly described the very thing claimed. Thus, the "teaching away" argument was not only "insufficient", it was irrelevant.

Independent claim 10 sets forth a thermal interface product comprising the thermal interface described in claim 1 further in combination with "a removable protective covering overlying the pliable, thermal compound layer".

Applicants' earlier remarks regarding the patentability of independent claims 1 and 22 over Green in view of Brzezinski are applicable to the rejection of claim 10.

The Tzeng patent relates to a release-lined, pressure sensitive adhesive, flexible graphite thermal interface sheet. The Tzeng interface sheet comprises a flexible graphite substrate 11, an adhesive primer coating 12 on the substrate, a pressure sensitive adhesive coating 13 on the primer coating and a release liner 14 on the pressure sensitive adhesive coating. The release liner 14 is said to be easily removed without any significant delamination of the flexible graphite substrate. (Tzeng, 2/3-9.)

In an effort to meet the limitations of claim 10, the Examiner, at page 4 of the final Office Action (Paper No. 17), has inadequately described the coating 13 in the Tzeng reference. The coating is not simply a "pressure sensitive layer" as described by the Examiner, but a "PSA coating", that is, a pressure sensitive adhesive coating. (For example, Tzeng, 6/23-24.) There is nothing in any of the references to suggest to one skilled in the art that the release liner 14 which overlies the pressure sensitive adhesive coating in the Tzeng reference should be used to cover a layer of pliable, thermal compound such as silicone grease which is virtually the antithesis of an adhesive. Thus, the Examiner is incorrect in his assertion that "it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use removable protective layer as disclosed by Tzeng in the structure disclosed by Green as to protect the pliable thermal compound layer prior to installation". (Final Office Action, Paper No. 17, page 3.) The Examiner has not pointed to any part of either of the references to support that statement and,

indeed, cannot do so. The Examiner has simply seized upon the presence of a release liner in Tzeng and transferred that element -- divorced from its context -- to the Green reference, again, an improper hindsight reconstruction.

Accordingly, the rejections of independent claim 10 and claims 11 and 13-21 depending therefrom, should be reversed.

(3) The Examiner's Rejection Of Dependent Claim 12 As Unpatentable For Obviousness Over Green In View Of Brzezinski And Further In View Of Tzeng And Lee Is Erroneous

Claim 12 depends from independent claim 10. Accordingly, the comments made concerning the patentability of claim 10 over Green in view of Brzezinski and Tzeng are equally applicable to claim 12.

Dependent claim 12 further defines the "removable protective covering" set forth in claim 10 as comprising "a cap removably attached to the carrier". The rejection of claim 12 adds to Green, Brzezinski and Tzeng a fourth reference, the Lee patent.

Lee discloses a heat sink 30 for dissipating heat generated by a CPU. The heat sink includes a base 31, heat dissipating fins 32 projecting from the base and a layer of thermal grease 40 spread on a middle portion of the heat sink base. A protective cap 50 is removably attached to the base to enclose the thermal grease so that the grease will not cause contamination during transportation or handling of the heat sink. (Lee, 2/31-35.)

The inadequacy of the rejection of claim 12 is made manifest by the fact that the Examiner has made no attempt to show how the references can be combined in any rational way. The Examiner's statement that "[i]t would have been obvious...to have the protective removable cap as disclosed by Lee et al. in the device disclosed by Green et al. in order to protect pliable surface or thermal grease", is a conclusion

having no support whatever in the applied art. Once again, it is submitted that the Examiner has simply extracted an element from the prior art and used the claims in issue themselves as a road map in an attempt to come up with the claimed combination -- again, a classical example of a hindsight reconstruction.

Accordingly, the rejection of claim 12 should be reversed.

9. Conclusion

It is submitted that the Examiner has failed to carry the burden of establishing a *prima facie* case of obviousness. Not only is at least one claimed limitation missing from the references, but there is no suggestion for combining the applied references as urged. There has not been cited, and it is submitted that the Office cannot cite, any suggestion in the art that the references relied upon, either by themselves or in combination, meet the limitations of the rejected claims.

For the reasons stated, it is respectfully submitted that the Examiner's rejections are in error. The Examiner's rejections should be reversed and claims 1-30 should be allowed.

Respectfully submitted,

Dated: February 23, 2004

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APPENDIX

The Claims On Appeal

1. A thermal interface comprising:

a carrier having opposed surfaces;

a layer of a phase-change material on one of the surfaces of the carrier; and

a layer of a pliable, thermal compound on the other of the surfaces of the carrier.

2. The thermal interface of claim 1 in which:

the carrier comprises a thermally-conductive material.

3. The thermal interface of claim 2 in which:

the thermally-conductive material comprises a metal foil.

4. The thermal interface of claim 2 in which:

the thermally-conductive material comprises a thin, thermally-conductive plastic sheet.

5. The thermal interface of claim 2 in which:

the carrier comprises a material selected from the group consisting of copper, gold, silver, aluminum and plastic.

6. The thermal interface of claim 1 in which:

the phase-change material comprises a paraffin-base material.

7. The thermal interface of claim 1 in which:

the pliable, thermal compound comprises a thermally conductive grease.

8. The thermal interface of claim 7 in which:

the thermally-conductive grease comprises a silicone-type grease.

9. The thermal interface of claim 1 in which:

the pliable, thermal compound comprises a thermally-conductive paste.

10. A thermal interface product comprising:

a carrier having opposed surfaces;

a layer of a phase-change material on one of the surfaces of the carrier;

a layer of a pliable, thermal compound on the other of the surfaces of the carrier; and

a removable protective covering overlying the pliable, thermal compound layer.

11. The thermal interface product of claim 10 in which:

the removable protective covering comprises a peelable backing.

12. The thermal interface product of claim 10 in which:

the removable protective covering comprises a cap removably attached to the carrier.

13. The thermal interface product of claim 10 in which:

the carrier comprises a thermally-conductive material.

14. The thermal interface product of claim 13 in which:

the thermally-conductive material comprises a metal foil.

15. The thermal interface product of claim 13 in which:

the thermally-conductive material comprises a thin, thermally-conductive plastic sheet.

16. The thermal interface product of claim 13 in which:

the carrier comprises a material selected from the group consisting of copper, gold, silver, aluminum and plastic.

17. The thermal interface product of claim 10 in which:

the phase-change material comprises a paraffin-base material.

18. The thermal interface product of claim 10 in which:

the pliable, thermal compound comprises a thermally-conductive grease.

19. The thermal interface product of claim 18 in which:

the thermally-conductive grease comprises a silicone-type grease.

20. The thermal interface product of claim 10 in which:

the pliable, thermal compound comprises a thermally-conductive paste.

21. The thermal interface product of claim 11 in which:

the peelable backing comprises a release liner.

22. An assembly comprising:

a substrate;

an electronic component mounted on said substrate;

a heat sink; and

a thermal interface interposed between a surface of said electronic component and a surface of said heat sink for transferring heat generated by said electronic component to said heat sink, said surfaces of said heat sink and said electronic component being in confronting relationship, said thermal interface comprising:

a carrier having opposed surfaces;

a layer of a phase-change material interposed between one of the surfaces of the carrier and one of said confronting surfaces of said heat sink and said electronic component; and

a layer of a pliable, thermal compound interposed between the other surface of the carrier and the other one of said confronting surfaces.

23. The assembly of claim 22 in which:

the carrier comprises a thermally-conductive material.

24. The assembly of claim 23 in which:

the thermally-conductive material comprises a metal foil.

25. The assembly of claim 23 in which:

the thermally-conductive material comprises a thermally-conductive plastic sheet.

26. The assembly of claim 22 in which:

the carrier comprises a material selected from the group consisting of copper, gold, silver, aluminum and thermally-conductive plastic.

27. The assembly of claim 22 in which:

the phase-change material comprises a paraffin-base material.

28. The assembly of claim 22 in which:

the pliable, thermal compound comprises a thermally-conductive grease.

29. The assembly of claim 28 in which:

the thermally-conductive grease comprises a silicone-type grease.

30. The assembly of claim 22 in which:

the pliable, thermal compound comprises a thermally-conductive paste.